

WHAT IS CLAIMED IS:

1. A micro-fluidic device having a fluid flow path and at least one micro-valve comprising a phase reversible material.
- 5 2. The micro-fluidic device according to Claim 1, wherein said device comprises two intersecting flow paths, wherein one of said flow paths is substantially filled with said phase reversible material and said micro-valve is positioned at the intersection of said intersecting flow paths.
- 10 3. The micro-fluidic device according to Claim 1, wherein said micro-valve comprises said phase reversible material stably associated with a high surface area component.
- 15 4. The micro-fluidic device according to Claim 3, wherein said high surface area component is stably associated with at least one wall of said fluid flow path.
5. The micro-fluidic device according to Claim 3, wherein said high surface area component is maintained in said flow path by a retaining means.
- 20 6. The micro-fluidic device according to Claim 1, wherein said phase reversible material is a phase reversible polymer.
7. The micro-fluidic device according to Claim 1, wherein said micro-valve  
25 modulates the rate of the fluid flow along said flow path.
8. The micro-fluidic device according to Claim 1, wherein said phase reversible material is thermo-reversible.
- 30 9. A micro-fluidic device comprising a micro-valve and two intersecting flow paths, wherein one of said intersecting flow paths is substantially filled with a phase

reversible material and said micro-valve is positioned at the intersection of said intersecting flow paths.

10. The micro-fluidic device according to Claim 9, wherein said micro-fluidic  
5 device comprises at least one micro-compartment.

11. The micro-fluidic device according to Claim 10, wherein said micro-compartment is a micro-channel.

10 12. The micro-fluidic device according to Claim 9, wherein said phase reversible material is a phase reversible polymer.

13. The micro-fluidic device according to Claim 12, wherein said phase reversible polymer is an N-isopropylacrylamide copolymer.

15 14. The micro-fluidic device according to Claim 12, wherein said phase reversible polymer is a polyalkylene oxide.

15. The micro-fluidic device according to Claim 9, wherein said micro-valve  
20 modulates the rate of the fluid flow along said flow path.

16. The micro-fluidic device according to Claim 9, wherein said phase reversible material is thermo-reversible.

25 17. A micro-fluidic device comprising a fluid flow path and at least one micro-valve, wherein said micro-valve comprises a phase reversible material stably associated with a high surface area component, and wherein said high surface area component is stably associated with at least one surface of said flow path.

30 18. The micro-fluidic device according to Claim 17, wherein said high surface area component comprises an array of posts bonded to said at least one surface of said flow path.

19. The micro-fluidic device according to Claim 17, wherein said micro-fluidic device comprises at least one micro-compartment.

20. The micro-fluidic device according to Claim 19, wherein said micro-compartment is a micro-channel.

21. The micro-fluidic device according to Claim 17, wherein said phase reversible material is a phase reversible polymer.

22. The micro-fluidic device according to Claim 21, wherein said phase reversible polymer is an N-isopropylacrylamide copolymer.

23. The micro-fluidic device according to Claim 21, wherein said phase reversible polymer is a polyalkylene oxide.

24. The micro-fluidic device according to Claim 17, wherein said micro-valve modulates the rate of the fluid flow along said flow path.

25. The micro-fluidic device according to Claim 17, wherein said phase reversible material is thermo-reversible.

26. A micro-fluidic device comprising a fluid flow path and at least one micro-valve, wherein said micro-valve comprises a phase reversible material stably associated with a high surface area component maintained in said flow path by a retaining means.

27. The micro-fluidic device according to Claim 26, wherein said retaining means comprises fluid permeable barriers positioned in said flow path on opposite sides of said high surface area component.

28. The micro-fluidic device according to Claim 26, wherein said retaining means comprises constrictions in said flow path present on either side of said high surface area component.

5 29. The micro-fluidic device according to Claim 26, wherein said high surface area component is selected from the group consisting of: a plurality of solid phase particles; a membrane; and a mesh structure.

30. The micro-fluidic device according to Claim 26, wherein said micro-fluidic  
10 device comprises at least one micro-compartment.

31. The micro-fluidic device according to Claim 30, wherein said micro-compartment is a micro-channel.

15 32. The micro-fluidic device according to Claim 26, wherein said phase reversible material is a phase reversible polymer.

33. The micro-fluidic device according to Claim 32, wherein said phase reversible polymer is an N-isopropylacrylamide copolymer.

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34. The micro-fluidic device according to Claim 32, wherein said phase reversible polymer is a polyalkylene oxide.

35. The micro-fluidic device according to Claim 26, wherein said micro-valve  
25 modulates the rate of the fluid flow along said flow path.

36. The micro-fluidic device according to Claim 26, wherein said phase reversible material is thermo-reversible.

30 37. A method of modulating fluid flow along a flow path of a micro-fluidic device, said method comprising:

modulating the physical state of a micro-valve positioned in said flow path,  
wherein said micro-valve comprises a phase reversible material.

38. The method according to Claim 37, wherein said phase reversible material is a  
5 phase reversible polymer.

39. The method according to Claim 38, wherein said phase reversible polymer is a  
thermoreversible polymer.

10 40. The method according to Claim 37, wherein said modulating comprises  
changing the temperature of said thermoreversible polymer.

41. The method according to Claim 37, wherein said modulating occurs by  
actuation of a phase reversing means.

15 42. The method according to Claim 41, wherein said phase reversing means is  
completely external to said device.

43. The method according to Claim 41, wherein at least one component of said  
20 phase reversing means is internal to said device.

44. A kit for use in a fluid flow process, said kit comprising:  
a micro-fluidic device according to Claim 1.

25 45. The kit according to Claim 44, wherein said kit further comprises a phase  
reversing means.